

AF-902/AF-904[®] Generation II Digital FSK Track Circuits

Major Components

Like its AF-900 Series predecessor, the AF-902/AF-904 Generation II (AF-Gen II) Track Circuit outperforms the functions of earlier AF-based systems while using a much simpler configuration of equipment house modules and track-mounted apparatus. For example, installation and maintenance requirements for the AF-Gen II Track Cable Bonds are much simpler than the impedance and mini bonds of traditional systems.

The AF-Gen II System Cardfile features a simpler PCB arrangement than the previous AF-900 Series unit, incorporating only two types of boards. The original Controller PCB is replaced with a more advanced Track Circuit System (TCS) board. This board incorporates new Ethernet-based features such as peer communications, integral Web server user interface and SNMP remote monitoring. The TCS also performs the track transmit/receive functions of the earlier Auxiliary board.

Most notable, existing AF-900 Series Track Circuit cardfiles can be retrofit with the new AF-Gen II PCBs. No rewiring of cardfile power and data interfaces is needed.

System Cardfile

The AF-Gen II System Cardfile performs all logical functions related to train detection, cab signal data transmission and communications with Track MicroLok II units, as well as conducting continuous internal and local system diagnostics. Only six boards are contained in the cardfile for all non-redundant (AF-904-style) and redundant (AF-902-style) applications. Only two different types of boards comprise the 6-board set:

- Track Circuit System PCB – Vital logic, track transmissions, receptions, remote communications (serial or Ethernet), internal diagnostics, user configuration, track transmitter power, track receiver circuits.
- Power Supply PCB – Operating power for all cardfile PCBs.

A key reliability feature of the AF-Gen II Track Circuit is its redundant design, an essential element of driverless train operations. In the “AF-902” configuration, the System Cardfile incorporates primary and back-up sets of TCS and Power Supply boards for supervision of two track circuits.

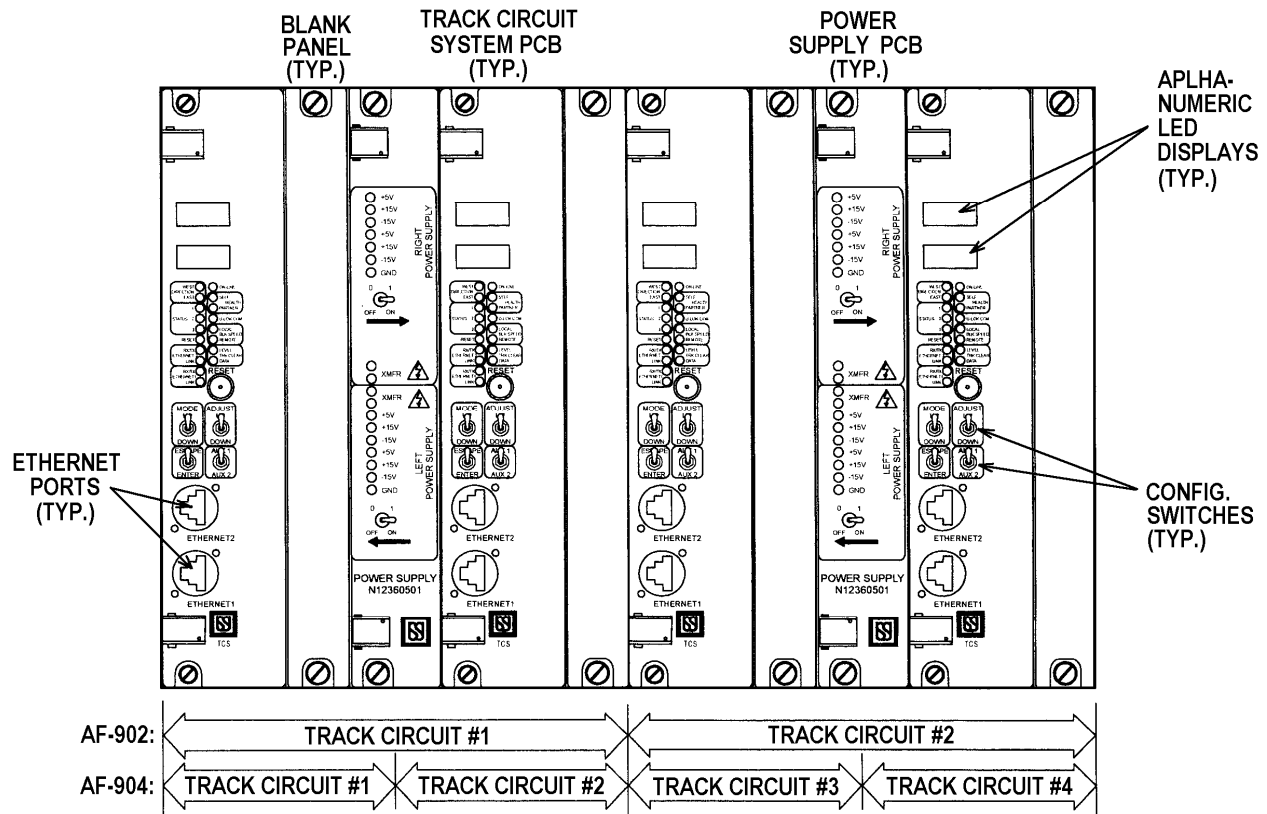


If the on-line “AF-902” subsystem detects an internal fault, control is immediately switched to the off-line subsystem. When this occurs, communications lines with the track and both MicroLok II systems (Track and Interlocking) are automatically switched.

For applications not requiring the degree of redundancy afforded by the “AF-902” configuration, the “AF-904” configuration of the AF-Gen II System Cardfile uses the same number and arrangement of PCBs as the 902. However, the cardfile is configured to allow the PCBs to control up to four track circuits. Both configurations of the cardfile automatically set the direction of track transmissions.

Like the earlier AF-900 Series Track Circuits, the AF-Gen II System Cardfile is designed to perform continuous internal and external diagnostics. In the event of a critical failure, the system is designed to block the transmission of cab signal data or an indication of a clear track.

To simplify field replacement of AF-Gen II TCS boards, each TCS board cardfile slot is equipped with a motherboard-mounted EEPROM. This device is used to store site-specific track circuit configuration data.



System Cardfile (cont'd)

If a TCS PCB must be replaced, no re-configuring of track circuit addressing parameter is needed. Only a track circuit calibration procedure must be re-run to verify settings and calculate new thresholds.

System Cardfile back panel interfaces include track circuit connections, serial ports for MicroLok II communications (when needed), calibration jumpers and power input. Because of the large dynamic range imposed by the needs of different track circuits, the AF-Gen II System Cardfile incorporates adjustable transformer taps for the different track receiver circuits. These allow for variables such as different track lead lengths. Adjustments are made via the back panel jumpers so that a system reset is not required with change-out of the track interface circuitry.

Track Circuit System (TCS) PCB

User Front Panel Interfaces

The TCS board incorporates the following user controls and indicators:

- Two alpha-numeric LED displays: Show on-site track circuit set-up and operation information.
- Four 2-position toggle switches: Enable the user to step through track circuit set-up procedures.

- System reset switch.
- Two Ethernet RJ-45 ports for:
 - Peer-based communications with MicroLok II
 - On-site monitoring, configuration and calibration using a laptop PC.
 - Remote system monitoring using an SNMP protocol.
- 18 LED for monitoring system functions such as selected direction (E or W), Ethernet channel 1 or 2 active, MicroLok II communications, etc.

User Interface Via Integral Web Server

The new AF-Gen II TCS board front panel contains two Ethernet ports. Each of these ports accommodates peer-based AF-GenII/MicroLok II communications, SNMP-based remote monitoring and Web server-based user interface. The Web server provides a convenient way to monitor system operation, as well as configure and calibrate AF-Gen II system operating parameters using Microsoft's Internet Explorer. All front panel operations can be performed using the Web interface.

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Ansaldo STS USA
(Formerly known as Union Switch & Signal)

RSE-1F2
Rev. 4-10

Local Block Speed = None
Walnut Street East 42- **TrackID: 42**

View Current Data | View Configuration | View Events | Front Panel View | Setup

View Current Data

Message	Message From Wayside	Track Message	Message To Wayside
Primary/Backup		Primary (1)	
Track I.D.		42 (000000101010)	
Direction	N/A (00)	N/A (00)	
Next Frequency	9.5 kHz (000)	9.5 kHz (000)	
Distance To Go	0 (0000000)	0 (0000000)	
Line Speed	0 (00000)	0 (00000)	
Target Speed	0 (00000)	0 (00000)	
Berthed	Train Not In Platform (0)	Train Not In Platform (0)	
Coupled/Uncoupled	No Action (00)	No Action (00)	
Bifurcation	Switch Point Reverse (0)	Switch Point Reverse (0)	
Remote Block Speed	0 (000000)		
Block Speed Set			No Local/Remote Block Speed (1)
Partner Health			Standby Not Available (0)
Occupancy			Unoccupied (1)
Correspondence			Direction In Correspondence (1)

Track Signal Level

Shunt Level	161%
Variance	0%
Receive Level	25

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Track Circuit System (TCS) PCB (cont'd)

The interface shows five primary pages:

- **View Current Data:** Communications with MicroLok II, track messages, current shunt level, track signal variance, etc.
- **View Configuration:** Display static configuration parameters (link to MicroLok II, Ethernet port addresses, SNMP, track circuit ID, etc.)
- **View Events:** Show AF Gen II system events, warnings and critical errors.
- **Front Panel View:** Shows all data displayed by the front panel discrete LEDs.
- **Setup:** Configure and calibrate AF-Gen II system (password-protected).

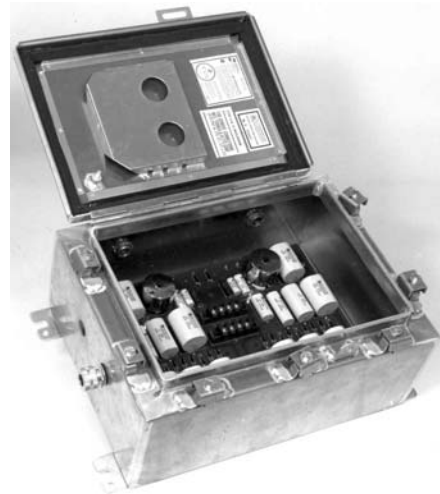
Track Coupling Unit

The AF-Gen II Track Coupling Unit interfaces the track signals with the System Cardfile receiver and transmitter circuits, and provides for tuning to the track circuit carrier frequency. This weather-proof, wayside-mounted unit contains two independent coupling circuits, each consisting of a transformer (for track voltage step-down) and a jumper-adjusted capacitor bank for frequency tuning. Each transformer/capacitor section serves a respective track circuit end.

Typical Coupling Unit Wayside Installation



Coupling Unit PCB Access



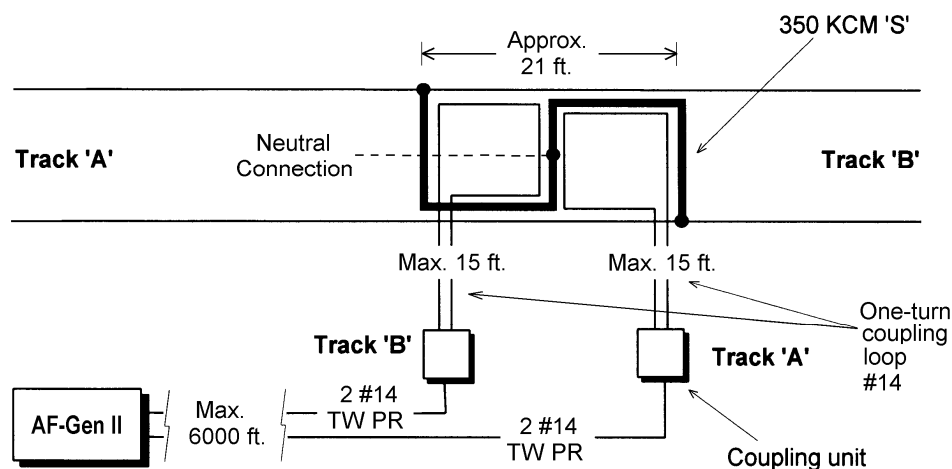
Track Cable Bond and Cab Loops

AF-Gen II Track Circuits use a simple but highly effective successor to the impedance or mini bond. This device is nothing more than a few meters of conductive cable, typically 350 or 500 thousand-circular-mill (MCM), arranged in an "S", "O" or "I" shape depending on track transmission/reception requirements for the particular installation. The end points of the Track Cable Bond are welded to the rails; signals are passed to and from the wayside electronics via a parallel "Track Loop" wire used to air-couple signals to and from the heavy, rail-connected cable.

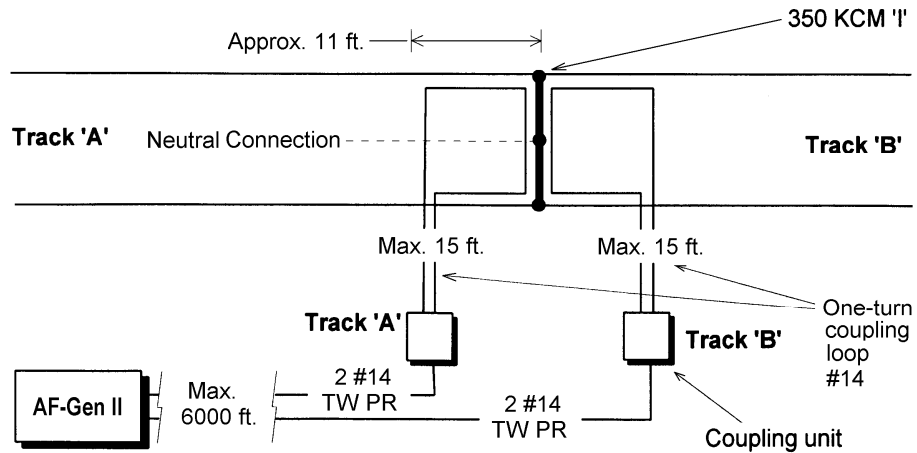
For crossovers and turnouts, AF-Gen II Track Circuits make use of standard Cab Loop cables, which are better suited for the high metal content (frogs etc.) at these locations (insulated joints retained).

Transmitting track signal currents circulating in the cable are induced into the rails, while received signals are induced into the cable from the rails. This type of bond provides a strong directional vector using the dimensional placement of the cable (total length and width of the cable geometric shape) to set track signal direction.

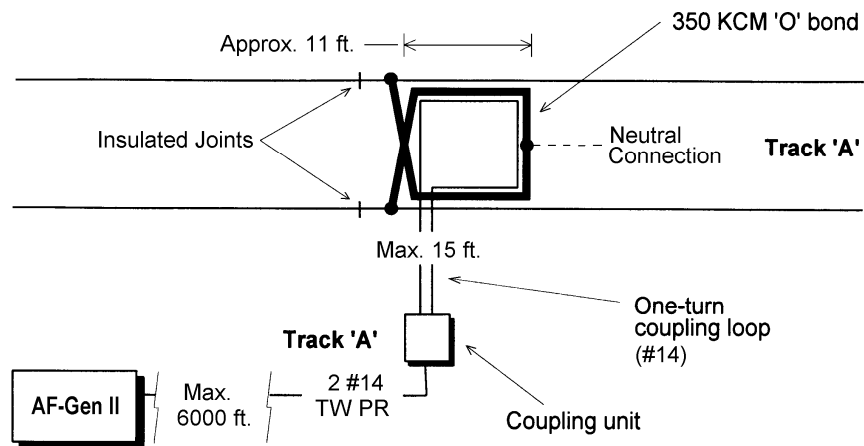
Typical "S" Track Cable Bond Application



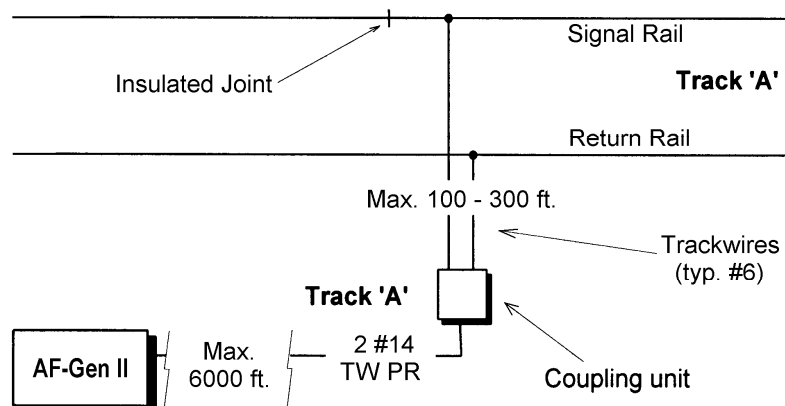
Typical "I" Track Cable Bond Application



Typical "O" Track Cable Bond Application



Typical Cable Bond Application: Direct Injection



Specifications

System Cardfile

T.C.'s Controlled:	"AF-902" style: Two (redundant) "AF-904": Four (non-redundant)
Mounting:	Standard 19 inch equipment rack
Plug-In PCBs:	6
Blank Panels:	4
Wiring:	Discrete-wire terminals for track connections. 25-pin "D" plug for serial links.
Ethernet Connection:	Two RJ-45 jacks per each TCS PCB (8 total per cardfile)
Environment:	-25°C to +70°C 95% relative humidity, non-condensing
Power Input:	110/240 Vac @50/60 Hz

Track Coupling Unit

Mounting:	Ground base, pedestal or wall.
External Wiring:	Via "T" conduit box to internal terminals.
Environment:	-40°C to +70°C, 95% humidity (non-condensing)
Power Input:	Not required.
Field Adjustments:	Carrier freq. tuning via capacitor bank jumpers on internal PCB.

Track Cable Bond

Light Rail Applications:	600-750 Vdc traction (typical).
Type:	350 or 500 MCM insulated/jacketed cable.
Typical Length (e.g. "S")	39 ft. (12M)
Rail Elec. Attachment:	Welding via cable terminals.
Rail Mech. Attachment:	Flange clips
Ballast Placement:	Above or buried.
Neutral Connect. Point:	For cross-bonding, substation returns, catenary poles, structure ground, etc.
One-Turn Loop:	#12 AWG, insulated Max. loop wire length: 15 ft

Interfaces:

Cardfile/T.C.'s:	Via Tuned Coupling Units Twisted-pair #14 AWG, 6000 ft. (1820M) max., 100 ohms impedance max.
Cardfile/Track M-Lok II:	Ethernet: RJ-45 Serial: RS-485
Cardfile Power Input:	Commercial 110/240 Vac source, UPS-compatible
Cardfile Data D-load:	RS-232 (9-pin) front panel serial ports
Coupling Unit/Track:	1-turn loop, #12 AWG (stranded/insulated)

Ordering and Additional Information

- Refer to ordering tabulation on page 6 for AF-Gen II equipment part numbers.
- When ordering TCS and Power Supply boards to retrofit an existing AF-900 Series System Cardfile, contact your ASTS USA Account Executive to ensure a proper transition to the new boards.

- For additional information on AF-Gen II Track Circuit application possibilities, contact your ASTS USA Account Executive.
- For additional technical information on the AF-Gen II Track Circuit equipment, request ASTS USA Service Manual SM-1F2.0001.

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FSK Track Circuits
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**RSE-1F2
Rev. 4-10**

Ordering and Additional Information (cont'd)

AF-Gen II Track Circuit Cardfiles				
Order No.	System Type	Power Input	PCBs	Direction Relays
N12200201	AF-902	115 Vac	X	X
N12200202	AF-902	115 Vac	--	X
N12200203	AF-904	115 Vac	X	X
N12200204	AF-904	115 Vac	--	X
N12200205	AF-902	230 Vac	X	X
N12200206	AF-902	230 Vac	--	X
N12200207	AF-904	230 Vac	X	X
N12200208	AF-904	230 Vac	--	X
N12200209	AF-904	115 Vac	X	--
N12200210	AF-904	115 Vac	--	--

AF-Gen II Cardfile PCBs and Panels			
Order No.		Order No.	
N12361001	Track Circuit System PCB	N451850-2902	Blank Panel
N12360501	Power Supply PCB		(single-width)

AF-902 and AF-904 Track Coupling Units	
Order No.	
N37500601	Coupling Unit for inductively-coupled locations (e.g. "S" bonds)
N37500603	Coupling Unit for "direction-injection" locations (e.g. crossovers)
N37500604	Coupling Unit for "cab loop" locations

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